REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the Office Action of May 21, 2010 is respectfully requested.

By this Amendment, claims 1-3, 11, 12, 15-18 and 21 have been amended, and new claims 29 and 30 have been added. Thus, claims 1-30 are currently pending in the application. No new matter has been added by these amendments.

On page 2 of the Office Action, the Examiner rejected claims 12-22 under 35 U.S.C. § 112, second paragraph, as being indefinite. In particular, the Examiner indicates that the word "type" in the phrase "vertical-type reactor" renders the claims indefinite. In this regard, it is noted that all instances of the phrase "vertical-type reactor" in the claims have been amended to appear as "vertical reactor." Accordingly, it is respectfully submitted that the Examiner's § 112 rejection is not applicable to the amended claims.

On pages 3-6 of the Office Action, the Examiner rejected claims 1, 2, 9-11, 23 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Lee et al. (US 5,061,377). On pages 6-8 of the Office Action, the Examiner rejected claims 12, 13 and 16-20 under 35 U.S.C. § 103(a) as being unpatentable over Chervenak et al. (US 3,322,665). Further, on pages 8-10 of the Office Action, the Examiner rejected claims 14, 15, 21 and 22 under 35 U.S.C. § 103(a) as being unpatentable over Chervenak in view of the additionally cited prior art. For the reasons discussed below, it is respectfully submitted that these claims, including independent claims 1, 2, 11 and 12, are clearly patentable over the applied prior art.

Independent claim 1 recites a method of producing sub-critical water decomposition products. The method of claim 1 includes continuously supplying material to be processed into a vertical reactor through an inlet provided for the reactor, whose interior is kept at a sub-critical condition for water. The method of claim 1 also includes *continuously taking out a liquid containing a decomposition product through any one of a plurality of outlets provided at a different position from a position where the inlet of the reactor is provided, to adjust residence time of the liquid containing the decomposition product in the reactor.*

Lee discloses a pipeline reactor which, as shown in Fig. 1, includes a reactor 12 comprising a sinuous pipeline 24 having diffusers 22, 122, 222 arranged at positions corresponding to reaction zones 26, 28 and 30.

However, as noted by the Examiner on page 3 of the Office Action, Lee does not disclose

continuously taking out a liquid containing a decomposition product through any one of a plurality of outlets provided at a different position from a position where the inlet of the reactor is provided, to adjust residence time of the liquid containing the decomposition product in the reactor, as required by claim 1.

In this regard, the Examiner notes that Lee discloses multiple sampling lines 42, 58, 66 and 70 for sampling the flowing liquid at various points along the assembly. Further, the Examiner notes that Lee discloses monitoring additional parameters of the reactor, such as temperature. In this regard, the Examiner asserts that one of ordinary skill in the art would have recognized that continuously sampling the liquid from the sampling lines would allow continuous monitoring of the reaction, and therefore concludes that it would have been obvious to one of ordinary skill in the art to continuously sample the liquid from the reactor of Lee.

However, it is noted that Lee merely discloses that the fluid can be sampled through the sampling lines, and does not disclose or suggest continuously taking out a liquid containing a decomposition product to adjust residence time of the liquid containing the decomposition product in the reactor, as required by claim 1.

Further, the mere disclosure of sampling lines would not have suggested to one of ordinary skill in the art that the sampling lines would be used to continuously remove liquid from the reactor. In this regard, it is noted that while Lee discloses monitoring additional parameters within the reactor, such as temperature and pressure (as noted by the Examiner), it is noted that Lee discloses that these parameters are monitored by corresponding components, such as temperature indicators, pressure gauges and flow meters, as disclosed in column 6, lines 9-20. Accordingly, as Lee discloses multiple devices for monitoring the various parameters within the reactor, one of ordinary skill in the art would not have continuously taken out the flowing liquid from the sampling lines of Lee in order to continuously monitor the reaction, as suggested by the Examiner.

Accordingly, for the reasons discussed above, it is respectfully submitted that it would not have been obvious to one of ordinary skill in the art to modify Lee so as to result in a method which includes continuously taking out a liquid containing a decomposition product through any one of a plurality of outlets provided at a different position from a position where the inlet of the reactor is provided, to adjust residence time of the liquid containing the decomposition product in the reactor, as required by independent claim 1.

Independent claim 2 recites a method of producing sub-critical water decomposition products. The method of claim 2 includes continuously supplying material to be processed into a vertical reactor through an inlet provided for the reactor, whose interior is kept at a sub-critical condition for water, and *continuously taking out a liquid containing a decomposition product through any one of a plurality of outlets provided at a different position from a position where the inlet of the reactor is provided, to form desired steady concentration profiles of the decomposition product in the reactor*. The method of claim 2 also includes taking out the desired decomposition product through at least one of the outlets, the at least one of the outlets being provided at a position where the concentration of the desired decomposition product is high.

Lee does not disclose a method which includes *continuously taking out a liquid containing a decomposition product through any one of a plurality of outlets provided at a different position from a position where the inlet of the reactor is provided, to form desired steady concentration profiles of the decomposition product in the reactor*, as required by independent claim 2.

In particular, on page 4 of the Office Action, the Examiner again suggests that it would have been obvious to continuously take out liquid through the sampling lines of Lee. Further, the Examiner indicates that Lee discloses the production of a steady stream of liquid with gas bubbles, which corresponds to the formation of *desired steady concentration profiles of the decomposition product in the reactor*, as required by claim 2. However, it is first noted that the production of a "steady stream of liquid with gas bubbles" does not correspond to the formation of desired steady concentration profiles of the decomposition product in the reactor, as the gas bubbles in Lee are not the decomposition product. Further, Lee discloses that the amount of oxygen in the liquid decreases as the liquid flows through the reaction zones, and that the amount of oxygen is replenished at each of the diffusers 22, 122, 222 (see column 5, line 42 through column 6, line 4).

Thus, in addition to the fact that the oxygen is not the decomposition product in Lee, Lee also does not disclose the formation of steady concentration profiles of the oxygen in the liquid, as the concentration of the oxygen in the liquid fluxuates significantly as the liquid flows through the reactor of Lee.

Further, as indicated above, as Lee discloses multiple devices for monitoring the various

parameters within the reactor, one of ordinary skill in the art would not have continuously taken out the flowing liquid from the sampling lines of Lee in order to continuously monitor the reaction, as suggested by the Examiner.

Accordingly, for the reasons discussed above, it is respectfully submitted that it would not have been obvious to one of ordinary skill in the art to modify Lee so as to result in a method which includes continuously taking out a liquid containing a decomposition product through any one of a plurality of outlets provided at a different position from a position where the inlet of the reactor is provided, to form desired steady concentration profiles of the decomposition product in the reactor, as required by independent claim 2.

Amended independent claim 11 recites an apparatus for sub-critical water decomposition treatment, comprising a reactor configured to decompose material to be processed using sub-critical water, heating means for heating a mixture composed of water and the to be processed material to form and keep sub-critical conditions for water, and compressing means for compressing the mixture. Further, claim 11 recites introducing means for introducing the material to be processed into the reactor, an inlet through which the material to be processed is to be introduced into the reactor, and a plurality of outlets for letting out a mixture of a decomposition product and water from the reactor, wherein the outlets are provided at respective positions which are different from one another in a flow direction of the sub-critical water, and which are different from a position at which the inlet is provided. In addition, claim 11 recites that the *reactor is a vertical reactor in which liquid flows in only one vertical direction.*

Lee discloses a pipeline reactor which, as shown in Fig. 1, includes a reactor 12 comprising a sinuous pipeline 24 having diffusers 22, 122, 222 arranged at positions corresponding to reaction zones 26, 28 and 30.

However, Lee does not disclose or suggest that the reactor is *a vertical reactor in which liquid flows in only one vertical direction*, as required by independent claim 11. Rather, Lee discloses that the reactor is a sinuous pipeline 24, in which liquid flows in a horizontal direction and two different vertical directions, as is clearly shown in Fig. 1, and therefore does not disclose or suggest a vertical reactor in which liquid flows in only one vertical direction, as required by independent claim 11.

Accordingly, as Lee does not disclose or suggest a vertical reactor in which liquid flows

in only one vertical direction as required by claim 11, it would not have been obvious to one of ordinary skill in the art to modify the reactor of Lee so as to result in the device of claim 11.

Therefore, for the reasons presented above, it is believed apparent that the present invention as recited in independent claims 1, 2 and 11 is not disclosed or suggested by the Lee reference. Accordingly, a person having ordinary skill in the art would clearly not have modified the Lee reference in such a manner as to result in or otherwise render obvious the present invention of independent claims 1, 2 and 11.

Independent claim 12 recites an apparatus for sub-critical water decomposition treatment, comprising *a vertical reactor configured to decompose material to be processed with sub-critical water*, heating means for heating a mixture of water and the material to be processed and compressing means for compressing the mixture, so as to form and keep a sub-critical condition for water. Further, the apparatus of claim 12 includes introducing means for introducing the material to be processed into the reactor, an inlet through which the material to be processed is to be introduced into the reactor, and an outlet for letting out a mixture of water and a decomposition product from the reactor, wherein the reactor is arranged substantially vertically and the inlet is provided for at least one of a top end portion or a bottom end portion of the reactor.

In addition, claim 12 recites that *the introduced mixture of the material to be processed and the sub-critical water is caused to flow, in the sub-critical water in a steady state, in an opposite direction to a direction in which the solid matter travels*, so as to form in the flow, in the following order from upstream of the flow, at least a fluidized bed in which the solid matter is decomposed into fine particles with the sub-critical water and the fine particles fluidize in the flow, and a sub-critical water dissolution part in which the material to be processed is turned into further finer particles or completely into a soluble material to flow with the sub-critical water, and to further form, depending on the material to be processed, a fixed bed in which solid matter stays in a fixed position even with the flow, the fixed bed being formed upstream of the fluidized bed, and wherein *a position of the outlet is adjustable so as to let out the sub-critical water dissolution part and adjust a distance through which the sub-critical water dissolution part flows*.

Chervenak discloses a device for high conversion hydrogenation of heavy gas oil which,

as shown in Fig. 1, includes a fractionator 64. Chervenak also discloses that the fractionator 64 separates a liquid product into a light gas product, a naphtha product, furnace oil and heavy gas oil.

Chervenak does not disclose a vertical reactor configured to decompose material to be processed with sub-critical water, and that the introduced mixture of the material to be processed and the sub-critical water is caused to flow, in the sub-critical water in a steady state, in an opposite direction to a direction in which the solid matter travels, so as to form the fixed bed, fluidized bed and sub-critical water dissolution part as recited in claim 12. However, on page 6 of the Office Action, the Examiner indicates that the fractionator 64 of Chervenak is fully capable of performing the functions of the reactor as recited in claim 12.

In this regard, however, it is noted that the fractionator 64 of Chervenak is not capable of functioning as a reactor in which *the introduced mixture of the material to be processed and the sub-critical water is caused to flow, in the sub-critical water in a steady state, in an opposite direction to a direction in which the solid matter travels*, so as to form the fixed bed, fluidized bed and sub-critical water dissolution part as required by independent claim 12.

Rather, although not explicitly shown in Chervenak, one of ordinary skill in the art would recognize that fractionators such as the one disclosed in Chervenak would include trays which extend from opposite walls of the fractionator in an alternating manner to define a flow path which alternates back and forth. In such a fractionator, as the mixture in the fractionator boils, vapors rise upward in the fractionator, condense on the plates, and then cascade back down the plates into the liquid at the bottom of the fractionator.

In this regard, it is noted that if the fractionator 64 of Chervenak were used as a vertical reactor configured to decompose material to be processed with sub-critical water, the fractionator 64 of Chervenak would not be capable of allowing *the introduced mixture of the material to be processed and the sub-critical water to flow, in the sub-critical water in a steady state, in an opposite direction to a direction in which the solid matter travels, so as to form the fixed bed, fluidized bed and sub-critical water dissolution part*, as the series of plates which would be arranged within the fractionator 64 of Chervenak would create a flowpath that would substantially impede the ability of the mixture of the material to be processed and the sub-critical water to flow in a steady state in an opposite direction to a direction in which the solid matter travels, and that would significantly reduce the ability for the fixed bed, fluidized bed and sub-

critical water dissolution part to be formed in the specific manner recited in claim 12.

Further, as noted by the Examiner on page 7 of the Office Action, Chervenak does not disclose a compressing means for compressing the mixture in the fractionator. In this regard, the Examiner notes that Chervenak discloses the use of a pump on the recirculating line, and concludes that it would have been obvious to one of ordinary skill in the art to use a pump in order to pressurize the contents of the fractionator.

However, even if the fractionator were modified to include a pump as suggested by the Examiner, it is noted that the fractionator of Chervenak would not be capable of performing the functions of a reactor in which *the introduced mixture of the material to be processed and the sub-critical water is caused to flow, in the sub-critical water in a steady state, in an opposite direction to a direction in which the solid matter travels*, so as to form the fixed bed, fluidized bed and sub-critical water dissolution part as required by independent claim 12.

Accordingly, it is respectfully submitted that it would not have been obvious to one of ordinary skill in the art to modify the device of Chervenak so as to result in or render obvious the invention of independent claim 12.

In addition, it is respectfully submitted that the additional prior art references applied by the Examiner do not cure the defects of the Lee and Chervenak references as discussed above.

Further, on page 10 of the Office Action, the Examiner indicates that claims 3-8, 24, 25, 27 and 28 are allowed. In this regard, it is noted that a minor amendment has been made to claim 3 to remove the word "type" from the phrase "vertical-type reactor." No other changes have been made to claims 3-8, 24, 25, 27 and 28, and therefore it is respectfully submitted that these claims remain allowed at least for the reasons indicated by the Examiner.

Therefore, it is respectfully submitted that independent claims 1-4, 11 and 12, as well as claims 5-10 and 13-30 which depend therefrom, are clearly allowable over the prior art of record.

In addition, the Examiner's attention is directed to the dependent claims which further define the present invention over the prior art. For example, dependent claims 29 and 30 each recite that the reactor is *a vertical reactor in which liquid flows in only one vertical direction*. As indicated above, Lee discloses that the reactor is a sinuous pipeline 24, in which liquid flows in a horizontal direction and two different vertical directions, as is clearly shown in Fig. 1, and therefore Lee does not disclose or suggest continuously supplying material to be processed into a vertical reactor in which liquid flows in only one vertical direction, as required by claims 29 and

30.

As another example, dependent claim 15 recites that the reactor is provided with *monitoring means through which the interior is visualized.* On page 9 of the Office Action, the Examiner cites Kleiss (US 3,830,698) as disclosing a reactor which includes multiple sensors for producing temperature gradient signals. In this regard, the Examiner indicates that it would have been obvious to one of ordinary skill in the art to convert temperature gradient signals to be visualized on a computer. However, it is noted that such a modification would only result the temperature gradient being visualized, and not the interior of the reactor, as required by claim 15.

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is clearly in condition for allowance. An early notice to that effect is respectfully solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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